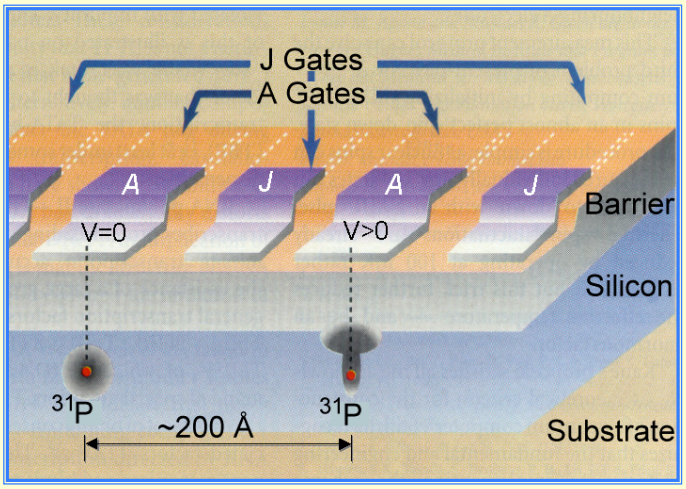
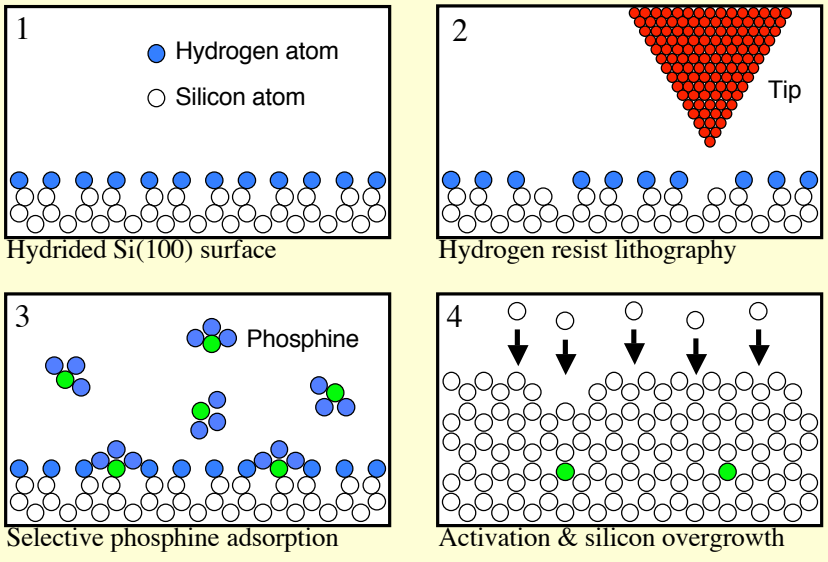
Toward a Scaleable Solid-State Quantum Computer



Qubits are phosphorus atoms embedded in an isotopically pure ^{28}Si crystal at a spacing of 200 Å. An insulating barrier separates silicon from metal gate electrodes. "A" gates manipulate individual qubits. "J" gates control interactions between neighboring qubits.

B. Kane, *Nature* 393 , 133 (1998)

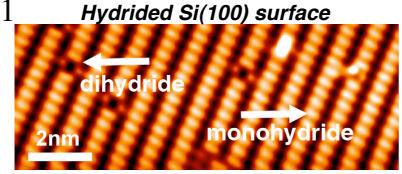
Bottom-up manufacture in the Scanning Tunneling Microscope

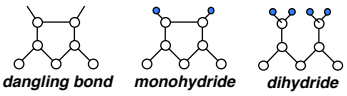


Presenter: Holger Grube

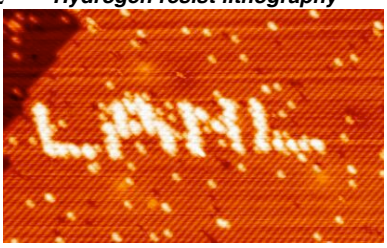
Demonstrated Processing Steps

1 *Hydrided Si(100) surface*

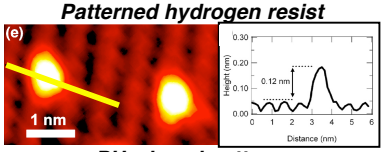




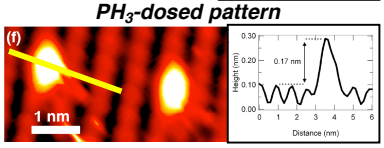
2 *Hydrogen resist lithography*



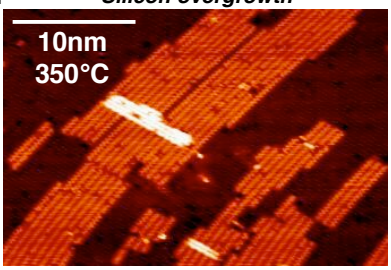
3 *Patterned hydrogen resist*



PH_3-dosed pattern



4 *Silicon overgrowth*



Ongoing efforts

Improve silicon overgrowth

- Understand and avoid antiphase domain boundaries
- Reduce surface roughness
- Investigate defects on overgrowth layer

Characterize stability of qubit array

- Image buried charges

Presenter: Holger Grube